

## **Predicting Solid Waste Degradation Rates in Landfills Using an Improved Anaerobic Assessment Tool**

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### **Abstract**

The test typically used to assess anaerobic biodegradability of liquid samples involves substrates being incubated along with seed, nutrient and buffers in 250 ml to 5 L bottles (Owen et. al., 1979; Bogner, 1990; and Wang et. al., 1994). The methane contribution resulting from sample decomposition is obtained by subtracting the background values (seed) from the total.

These tests are of little value for many solid samples, eg for current or historic landfilled solid waste. One concern is the need to modify the solid sample prior to testing. Most test methods involve drying, grinding, re-drying and re-grinding to 2mm or less. These modifications make the test results difficult to apply to field conditions. In addition, the steps involved in sample preparation could lead to oxygen exposure, which could distort the results. Finally, because of a small sample size of about 10-50g w/w, the test result may not be representative of the bulk material. A new tool is under design to enable analysis on larger sample sizes.

An anaerobic respirometer was made of 10 cm Ø PVC pipe measuring 43.5 cm long with 3600 ml capacity with caps at both ends. For easy sample introduction, one endcap is fixed while the other is screw capped. A distinctive feature is the wide neck opening of about 10 cm where solid samples can be introduced as is, without further sample modification. Valves are attached on the screw cap for gas analysis. For the test, substrate are incubated along with inocula at 35°C and mixed daily by manually shaking the anaerobic respirometer for about 40 seconds.

Using simulated food waste as a substrate, 120g of wet sample was successfully accommodated by the anaerobic respirometer as shown in Figure 1. The pH of the effluent at the end of the experiment was 7.4, 5.9, 5.5 and 5.7 for 120g, 160g, 200g and 240g respectively, indicating that for higher sample loading there is a potential to upset anaerobic digestion due to the presence of higher concentration of volatile organic acids. Successful food waste organic loading rate (OLR) for batch digestion was hence established to be 18 g VS/L.d.

The organic loading rate differs for different substrate depending on its biodegradability. Using pure sucrose (Sc10-30, Figure 2 and 3), starch (St10-30, Figure 2 and 4) and cellulose (C110-30, Figure 2), three levels of organic loading rate (10, 20 and 30 g VS/L.d) were tested. A higher organic loading is tolerable for the starch, but the organic loading tolerance decreased when sucrose was tested.

Research to date indicates that there is potential of the developed tool for various types of solid organic waste and conditions (blended, grinded, etc) provided that a suitable organic loading is determined. In conclusion, the anaerobic respirometer is reasonably durable, portable, cheap and easy to operate tool suitable for measuring anaerobic decomposition of solid samples.

## References

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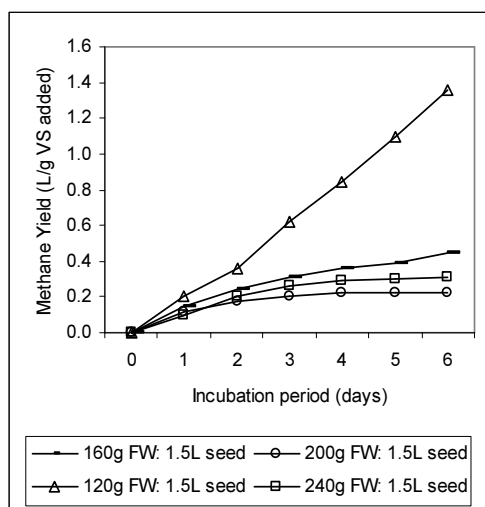


Figure 1. Gas production of various food waste (FW) loading, 120, 160g, 200g and 240g

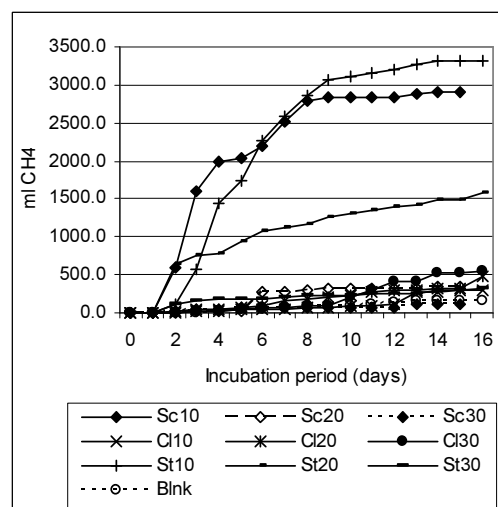


Figure 2. Cumulative gas production of simple, medium and complex carbohydrates, with three OLR; 10, 20 and 30 g VS/L.d

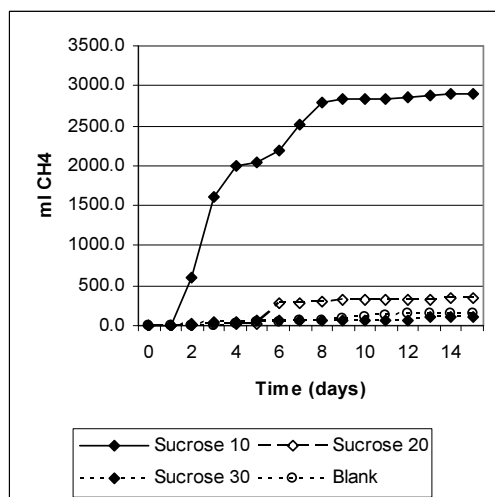


Figure 3. Cumulative gas production of sucrose (simple carbohydrate)

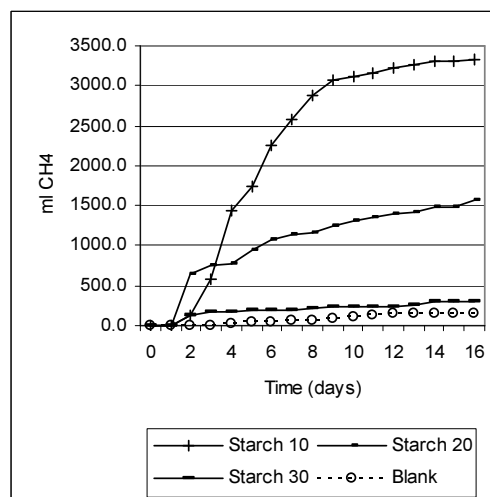


Figure 4. Cumulative gas production of starch (medium carbohydrate)